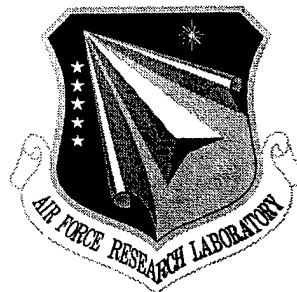AFRL-SN-RS-TR-2000-125
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August 2000

BANNER CORE SIMULATION INTERFACE

TASC

Lawrence Mabius

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**AIR FORCE RESEARCH LABORATORY
SENSORS DIRECTORATE
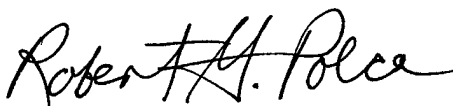ROME RESEARCH SITE
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13. ABSTRACT (Maximum 200 words)

The Banner Core Simulation Interface tool has been developed by Rome Laboratory to support the Banner Core program in evaluating Bistatic Radar Systems. This document provides a summary of the objectives of the Banner Core program, the software capabilities and the operational concept for the final delivered system, and the components of this system contained in Release 2.2.

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1. Overview

The Banner Core Simulation Interface tool has been developed by Rome Laboratory to support the Banner Core program in evaluating Bistatic Radar systems. This tool is based on the AMDF tool developed by Rome laboratory to support the Attack Management Development Facility (AMDF). The Software User's Manual (Reference 1) provides instructions on how to use and operate Release 2.2 of the Banner Core software. Appendix A of this Report provides instructions for installation of the Banner Core software.

In this document, we provide a summary of the objectives of the Banner Core program, the software capabilities and the operational concept for the final delivered system, and the components of this system contained in Release 2.2. For users who prefer to proceed directly to running the software, Chapter 2 of the Software User's Manual provides a brief overview of the key steps. Chapter 3 of the Software User's Manual gives a technical discussion of the simulation models included with this release. Chapters 4 through 9 of the Software User's Manual are the reference guide for all aspects of exercising the AMDF software (setting up the environment, building a simulation, importing user modules, executing the simulation, the run–time user interface, and post simulation analysis).

2. Objectives

The purpose of the Banner Core Simulation Interface is to serve as an evaluation facility for establishing the feasibility of Bistatic Radar noise suppression techniques. Banner Core will support experimentation and testing of Bistatic Radar subsystems and their noise suppression algorithms.

Banner Core provides interfaces to high-fidelity Bistatic Radar models including BRADS, GEMACS and XPATCH. Since Banner Core is a derivative of the AMDF reconfigurable simulation tool, it also provides a testbed for evaluating Acquisition, Point and Tracking and Fire Control (ATP-FC) subsystems and their decision function algorithms.

1

3. Capabilities

Banner Core supports the integration, evaluation, and demonstration of bistatic radar system concepts, subsystems and components. It accomplishes this by providing an environment that represents realistic physical phenomenology, bistatic radar system performance. The environment comprises a simulation capability within which users can integrate and test their applications software models, algorithms and databases. Banner Core provides the timing controls, data flow, tools and physical devices (i.e., terminals, visual and graphics displays, etc.) required to generate, collect, and analyze simulation data. This data will help bistatic radar technology developers to:

- Assess system and subsystem concepts for feasibility and effectiveness by analyzing system performance under realistic attack conditions

- Evaluate the feasibility of alternative approaches to various aspects of bistatic radar system design including requirements for onboard databases such as lethality estimates

- Perform timeline budget studies of weapon and computing systems, and establish flowdown of response time constraints.

Banner Core must evolve as bistatic radar platform algorithm developments mature to support the independent evaluation of contractor designs and the integration of a number of radar subsystem technologies. To accomplish this, the facility contains validated models, and provides a hardware and software framework that is flexible enough to support growth, reconfiguration, and simulation component modification and insertion. Banner Core is capable of hosting and executing user-developed software algorithms of radar platforms, subsystems, and functions for evaluation purposes.

3.1 Operational Features

Banner Core provides users with tools/models to support four operational capabilities:

- A bistatic radar platform Simulation Configuration Tool for building complete radar platform simulations, and providing the ability for users to select from a library or import their own algorithm, sensor, and structural models

- Analysis and Display Tools that support the evaluation of simulation data and the communication of test results to technical and program management personnel.

These capabilities support testing of alternative bistatic radar platform designs (hardware or processing algorithms) through the importation of the appropriate models into a common integrated platform simulation. The simulation is executed, the models' performance analyzed, and the results compared against other models evaluated in the same setting.

3.2 User Interaction Features

Key user interaction features include:

- Visualization of platform status through displays of the battle scene as seen by imaging sensors

- User-selectable data analysis and graphics display during the simulation execution as well as during post-simulation analysis

- Automated, graphical tools to permit the user to reconfigure the radar simulation, i.e., Plug and Play various software modules. These modules, either imported to Banner Core by the user or available in Banner Core program support library, represent different configurations of a bistatic radar system, its algorithms or altogether different components, e.g., sensors.

3.3 Bistatic Radar Simulation Features

The main capability of Banner Core includes models of the two subsystems:

- Radar Models including BRADS, XPATCH and GEMACS

- Platform structure models

- Pointing algorithms.

The BRADS model provides Bistatic Radar performance as a function of the transmitter and receiver antenna and target position and orientation as well as parameters which describe the radar and target characteristics. The XPATCH model generates receiver

3

output signal and a function of the transmitter signal strengthened orientation and the geometric characteristics specified in an XPATCH descriptor file.

The platform structure model provides dynamic emulation of the radar transmitter and receiver platform and subsystem position and orientation. The pointing algorithms generate commands to mechanically or electronically point the radar antennas.

4. Operational Concept

Banner Core may be used to support a variety of analysis objectives. This Section summarizes the ways in which a user can utilize the system.

Build the Simulation — The user can modify a baseline architecture to study the performance of alternative ATP-FC algorithms or platform models, or to assess alternative architectures. For example, the user could replace an ATP-FC algorithm (such as the plume to hardbody handover algorithm) with an alternative algorithm in order to assess relative performance.

Analyze the Simulation — A user can execute the simulation for this architecture directly to analyze the performance of a bistatic radar simulation. The user can vary simulation parameters, and modify scenarios to study the response of the bistatic radar.

Import and Utilize User–Developed Platform Models — Inherent in the above operations is the use of user-developed software. Banner Core supports importation of C and C++ software that models platform components (algorithms, sensors, and structures). There are specific interface requirements for the importation of user software. In order to import software, the user's software must be modified to meet these requirements and inserted into a C++ shell. In addition, a file must be pre-pared listing the inputs and outputs of the software. The software model can then be used in building a simulation (Plug and Play).

5. Software Components in Banner Core Release 2.2

The major software components of Banner Core Release 2.2 are the user interface (Building a Simulation), the simulation (consisting of the Simulation Executive, Platform Simulation, and Sensor Simulation), and the data analysis system (which utilizes the

4

commercial package, PV~WAVE). The software components operate on a Silicon Graphics Personal IRIS 4D/35G workstation.

Building a Simulation is the software tool that supports the user in setting up a simulation, configuring a platform architecture, executing the simulation, and managing simulation assets. Release 2.2 of Banner Core only supports the configuration function. The user configures a simulation by constructing block diagrams of the platform architecture. The tool generates the software and data files for the specified architecture. The elements of the block diagrams are selected from a library of algorithm software, and models for the platform's sensors, mirrors, illuminators, and structure. We refer to this process as "Plug and Play." User-developed software and architectures may be added to the libraries. This tool is written in the C language and utilizes the X Window System.

The **Simulation** consists of the Simulation Executive, the Radar Platform Simulation and the Radar Sensor Simulation. The Simulation Executive controls the initialization and execution of the Radar Platform and Sensors. The Radar Platform Simulation executes the models for the components of the platform; its executive software is generated by the user when building a simulation. The Radar Sensors includes all the models for bistatic radar sensor entities that utilize existing radar models. The simulation is written in the C++ programming language.

The **Data Analysis System** provides the user with graphical displays (e.g., plots, charts, images) of the data generated during a simulation. The commercial tool PV~WAVE™[1] is used to provide the analysis and display capability. The tool is used for post–simulation data analysis. Scripts written in the PV~WAVE user interface language are provided that automate the display of selected ATP–FC simulation data.

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[1] PV~WAVE™ is a visual data analysis software package developed and marketed by Visual Numerics, Inc., of Boulder, Colorado.

Appendix A
Installation of Banner Core

Setting up the Banner Core Infrastructure

1. Setup a user account named banner.
2. Login as that user.
3. Create a directory named "tarfiles"
   % mkdir tarfiles

4. Copy the Banner Core archive file into that directory
   (e.g. "banner_22.tar.Z")

5. From the home directory of banner, install the software
   % zcat tarfiles/ banner_22.tar.Z | tar xvf -

6. Edit the file ~banner/etc/manual and change the environment variable
   BANNER_CORE to the home directory of the banner account
   (e.g. setenv BANNER_CORE /home/banner)

7. Edit the file ~banner/pvwave/wvsetup and change the first executable line to "source"
   the "wvsetup" in the PV~WAVE directory
   (e.g. source /usr/local/pvwave/wave/bin/wvsetup)

8. Logout of the banner account
   % logout

REFERENCES

1. "Software User's Manual for the Banner Core Simulation Interface", TASC Technical Report TR-08005-1, September 1998.